ZOOLOGICAL SCIENCE 7: 755-761 (1990)

Two New Species of the Genus *Monhystrium* Cobb, 1920 (Monhysteridae: Nematoda) from Terrestrial Crabs of Subfamily Sesarminae (Brachyura) in Japan

KATSUKI YOSHIMURA

Ube Junior College, UBE 755, Japan

ABSTRACT—Two new species of *Monhystrium, M. tenuis* n. sp. and *M. brevis* n. sp. (Nematoda: Monhysteridae), are described from gill chambers of sesarmin crabs (Brachyura: Grapsidae), collected at Ube, Onoda and Shirahama, Japan. Host crabs of *M. tenuis* were *Parasesarma plicatum, P. pictum, P. erythrodactylum* and *Clistocoeloma merguiense,* inhabiting the upper littoral zone. *M. brevis* were found from *Chiromantes haematocheir, C. dehaani, Sesarmops intermedium* and *Chasmagnathus convexus,* which live mainly in the supralittoral zone. These nematodes supposedly feed on detritus fouling the gills of these crabs.

INTRODUCTION

Although the nematodes of the family Monhysteridae are primarily free living, some monhysterids are known to live epibiotically on terrestrial, limnetic and marine crustaceans such as *Astacus, Gecarcinus, Cardisoma, Gammarus, Orchestia, Ligia, etc.* [1-5, 8-11]. Among these nematodes, three species of the genus *Monhystrium* Cobb, 1920, i.e. *M. transitans* Cobb, 1920, *M. wilsoni* (Baylis, 1915), and *M. inquilinus* Riemann, 1969, have been described from the gill chambers of land crabs of the family Gecarcinidae (*Gecarcinus ruricola, G. lateralis,* and *Cardisoma guanhumi*) from Carribean coasts [1-3, 10, 11].

In Japan, gecarcinid crabs are restricted to the south of Tokara strait, though other land crabs of Sesarminae (family Grapsidae), are widely distributed from the northern part of the Honshu main island through the Ryukyu Islands [7]. They are common around river mouths, inhabiting upper intertidal zone or supralittoral zone according to their terrestrial adaptation. Among them, *Chiromantes haematocheir* is strongly adapted to terrestrial environment and scarcely comes down to touch sea water.

In order to find out whether Japanese land crabs carry such nematodes in their gill chambers, 11 species of Sesarminae and 4 species of Ocypodidae in the western part of Honshu were examined. As a result, 2 species of *Monhystrium* and 1 species of *Gammarinema* Kinne and Gerlach, 1953, another representative of nematodes living on body surfaces of crustaceans (Yoshimura, in preparation), were found from 8 species of Sesarminae. Other 3 sesarmins and 4 ocypodids were not infested by these nematodes. In this report, descriptions of 2 new species belonging to the genus *Monhystrium* are given, as well as some consideration on the relationship between these nematodes and their host crabs.

Accepted February 13, 1990
Received November 30, 1989

MATERIALS AND METHODS

The crabs examined are *Chiromantes haematocheir, C. dehaani, Parasesarma plicatum, P. pictum, P. erythrodactylum, Perisesarma bidens, Sesarmops intermedium, Helice tridens, H. japonica, Chasmagnathus convexus, Clistocoeloma merguiense, Uca lactea lactea, Scopimera globosa, Ilyoplax pusilla,* and *Macrophthalmus japonicus.* The scientific names for these sesarmin crabs are based on Miyake [7]. Most of them, except *Chiromantes haematocheir* and *Parasesarma plicatum,* were collected at several sites along Koto River in Ube, Yamaguchi Pref., from near the river mouth up to the limit of the tidal effect

(about 6 km upstream). *Chiromantes haematocheir* were captured at 50 to 100 m away from the river. *Parasesarma plicatum, P. pictum* and *P. erythrodactylum* were also obtained at a site 1.2 km from the mouth of Ariho River, in Onoda, Yamaguchi Pref. In addition, *Sesarmops intermedium* were collected near a small stream, close to an inlet of Tanabe Bay, in Shirahama on Kii Peninsula.

The samples of these crabs were obtained from May to August of 1988. After the crabs were fixed in 10% formalin, the carapace was removed, and the gills were picked out with forceps. They were placed in a petri dish containing a small amount of water, and were examined under a low magnification microscope for nematodes. When nematodes were found, they were transferred to a dilute solution of glycerine in 70% ethanol. After ethanol and water evaporated, the nematodes were mounted on a slide in pure glycerine.

DESCRIPTIONS OF SPECIES

Monhystrium tenuis n. sp.
(Fig. 1. a-e)

Materials studied: Holotype, male, S.M.B.L. Type No. 347, from gill chamber of adult *Parasesarma erythrodactylum* collected at 3.9 km from the mouth of Koto River in Ube on August 10, 1988. Allotype, female, S.M.B.L. Type No. 348, from gill chamber of adult *Parasesarma erythrodactylum* collected at 3.9 km from the mouth of Koto River in Ube on August 10, 1988. Paratypes, 4 males and 3 females from gill chambers of adult *Parasesarma erythrodactylum* collected at 3.9 km from the mouth of Koto River in Ube on august 10, 1988.

Description of males[1]:

♂1 (holotype)

$$\frac{-\quad 192\quad M\quad 1168}{17\quad 24\quad 28\quad 28}\ 1260\ \mu m;$$

a=45.0, b=6.6, c=13.7
spic=48 μm

♂2

$$\frac{-\quad 179\quad M\quad 1095}{16\quad 23\quad 27\quad 25}\ 1183\ \mu m;$$

a=43.8, b=6.6, c=13.4
spic=51 μm

♂3

$$\frac{-\quad 191\quad M\quad 1161}{16\quad 24\quad 28\quad 28}\ 1256\ \mu m;$$

a=44.9, b=6.6, c=13.2
spic=48 μm

♂4

$$\frac{-\quad 202\quad M\quad 1231}{16\quad 26\quad 30\quad 30}\ 1326\ \mu m;$$

a=44.2, b=6.6, c=14.0
spic=54 μm

♂5

$$\frac{-\quad 181\quad M\quad 1135}{16\quad 24\quad 27\quad 26}\ 1230\ \mu m;$$

a=45.6, b=6.8, c=12.9
spic=47 μm

Body slender, of almost equal diameter throughout boy length. Cuticle smooth, with minute sensory setae only in cephalic region. Amphids circular, about 2 μm wide, and located 10–12 μm (12 μm in holotype) behind anterior end, near base of buccal cavity. Head blunt and provided with 10 short cephalic setae, of almost equal length. No ocellus. Buccal cavity lacks denticles. Nerve ring at about 60% of esophagus length from anterior end. Neither ventral gland nor excretory duct visible. Intestine made up of about twenty large cells (oligocytous [6]) arranged into two rows (a ventral and a dorsal). Tail conical, 88–95 μm (92 μm in holotype) long, or 3.2–3.7 (3.3 in holotype) times as long as cloacal diameter. Bursa, or caudal ala, present in matured males on each subventral side around cloaca. Two papillae on lateral margin of each bursa. A pair of minute

[1] The numbers above the line refer to lengths from the anterior end to the end of the esophagus, the middle (M) of the body (male) or the vulva (female), and the anus. Those below the line refer to body widths at the level of cephalic setae, at the level of the nerve ring, at the middle of the body (male) or at the vulva (female), and at the anus. The subsequent measurement refers to the total body length. **a**, **b**, and **c** represent De Man ratios. In males, the length of the spicules (spic) is measured at their chord. In females, the position of the vulva is expressed as a percentage of the total body length.

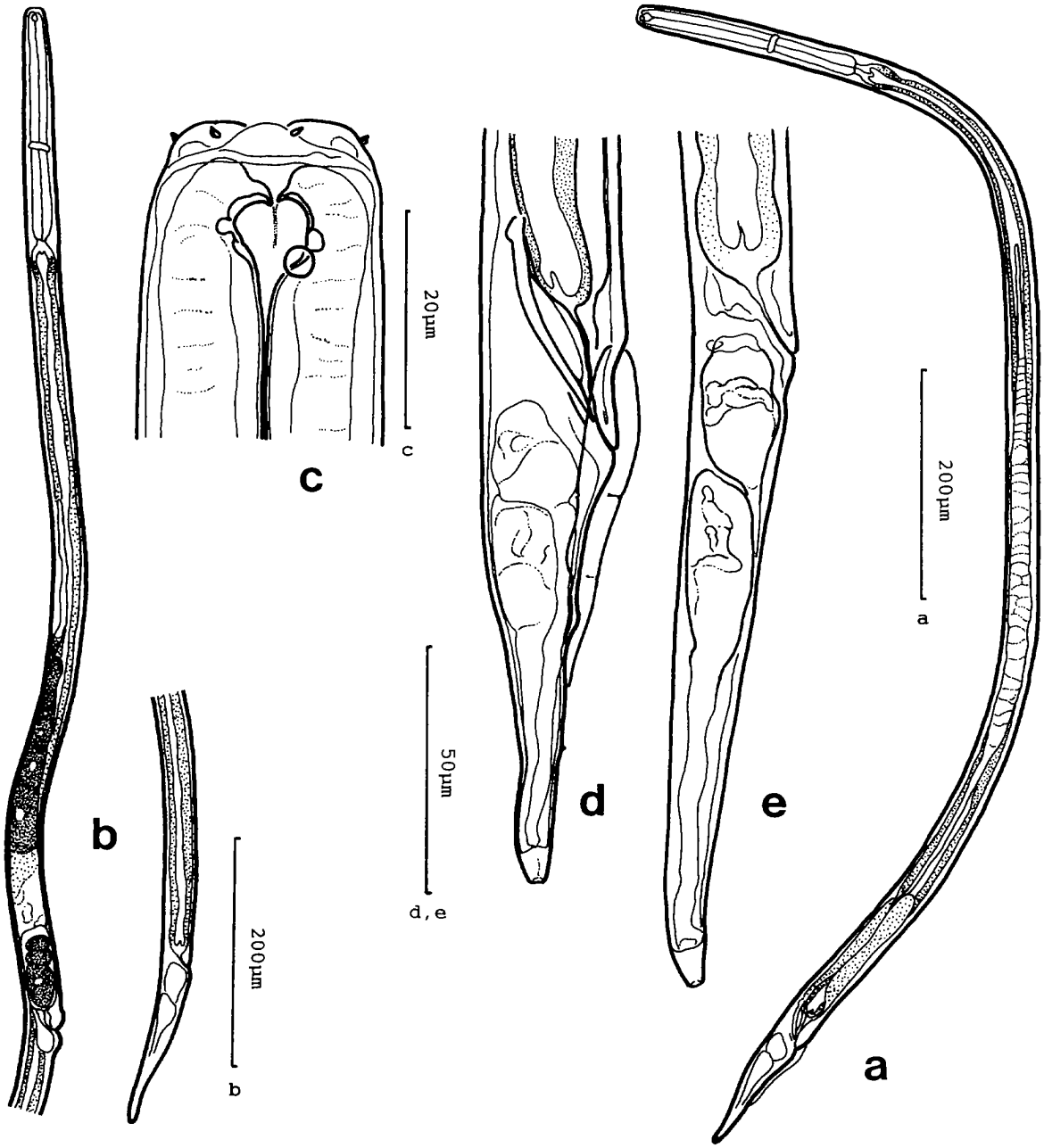

FIG. 1. *Monhystrium tenuis* n. sp. a. The total view of the holotype male. b. The total view of the allotype female. c. The anterior end of the holotype. d. The tail of the holotype. e. The tail of the allotype.

post-cloacal papillae present on subventral sides near tail end. Only two caudal glands. Single outstretched testis on right of intestine, anteriorly extends to 173–253 μm (213 μm in holotype) after base of esophagus. Spicules smooth, slightly cephalate proximally, with thin ventral alae, and 1.7–2.0 (1.7 in holotype) times as long as cloacal diameter. Gubernaculum only weakly developed and lies parallel to spicule dorsally.

Description of females:

♀$_1$ (allotype)

$$\frac{-\quad 195\quad 888\quad 1209}{14\quad 24\quad 30\quad 22}\ 1345\ \mu\text{m};$$

a=44.8, b=6.9, c=9.9

Vu=66.0%

♀$_2$

$$\frac{-\quad 196\quad 910\quad 1228}{16\quad 26\quad 31\quad 24}\ 1352\ \mu\text{m};$$

a=43.6, b=6.9, c=10.9

Vu=67.3%

♀3

—	204	972	1320	1455 μm;
16	28	32	22	

a=45.5, b=7.1, c=10.8
Vu=66.8%

♀4

—	196	959	1311	1447 μm;
16	27	30	22	

a=48.2, b=7.4, c=10.6
Vu=66.3%

Body rather longer than in males. Tail 124–136 μm (136 μm in allotype) long, or 5.2–6.2 (6.2 in allotype) times as long as anal diameter, and smooth, without anal alae nor caudal papillae. Gonad unpaired, outstretched, and lies to right of intestine. Vulva elevated. Uterus of allotype contains a large egg, 72×25 μm, which seems to have undergone the second cleavage.

Etymology: *tenuis* from their slender body shape.

Remarks: The present new species, *Monhystrium tenuis,* is similar to *M. inquilinus* Riemann, 1969 in the general body shape and the shape of the anterior end, but differs from the latter in that the body is much thinner, the tail is shorter, and the male lacks precloacal ventral spine.

The presence of a segmented egg in the uterus of the allotype suggests that the present new species is viviparous like the hitherto known species of *Monhystrium* [3]. This may be also supported by the occurrence of an embryo at just before hatching in a female of *Monhystrium tenuis* from a *Parasesarma* sp. collected at Ooshima Island, Yamaguchi Pref.

The present new species has been found from *Parasesarma plicatum, P. pictum, P. erythrodactylum,* and *Clistocoeloma merguiense,* though much scarce in *Parasesarma pictum.* Although I have examined dozens of *Perisesarma bidens,* no monhysterid nematodes have been found from their gill surface.

Monhystrium brevis n. sp.
(Fig. 2. a-f)

Materials studied: Holotype, male, S.M.B.L. Type No. 349, from gill chamber of adult *Chiromantes haematocheir* collected at a small hill near the mouth of Koto River in Ube on May 28, 1988. Allotype, female, S.M.B.L. Type No. 350, from gill chamber of adult *Chiromantes haematocheir* collected at a small hill near the mouth of Koto River in Ube on May 28, 1988. Paratypes, 3 males and 3 females from gill chambers of adult *Chiromantes haematocheir* collected at a small hill near the mouth of Koto River in Ube on May 28, 1988; a male and a female from gill chambers of adult *Chiromantes dehaani* at 6.3 km from the mouth of Koto River in Ube on June 17, 1988.

Description of males:

♂1 (holotype)

—	142	M	847	933 μm;
14	29	34	24	

a=27.4, b=6.6, c=10.8
spic=43 μm

♂2

—	144	M	926	1013 μm;
14	25	30	24	

a=33.8, b=7.0, c=11.6
spic=60 μm

♂3

—	147	M	955	1041 μm;
14	28	35	29	

a=29.7, b=7.1, c=12.1
spic=48 μm

♂4

—	130	M	778	866 μm;
13	28	31	23	

a=27.9, b=6.7, c=9.8
spic=46 μm

♂5

—	134	M	815	896 μm;
—	24	28	23	

a=32.0, b=6.7, c=11.1
spic=57 μm

Body short and thick, of almost equal diameter throughout body length. Cuticle exclusively smooth, with minute sensillae only in cephalic region. Amphids circular and about 2 μm wide, situated 10–12 μm (10 μm in holotype) behind anterior end, near base of buccal cavity. Head blunt and provided with 10 short cephalic setae of almost equal length. No ocellus. Buccal cavity

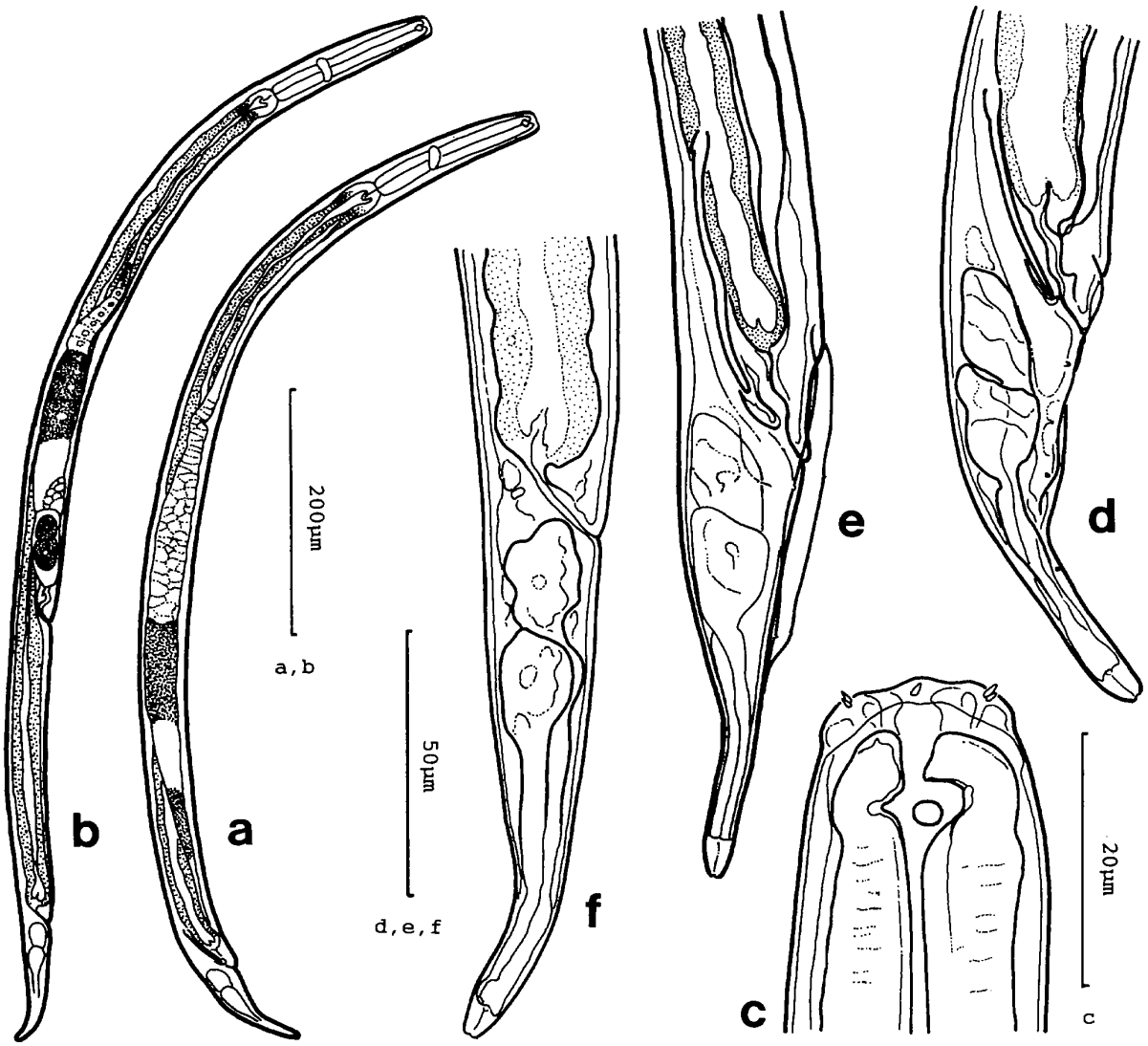

FIG. 2. *Monhystrium brevis* n. sp. a. The total view of the holotype male. b. The total view of the allotype female. c. The anterior end of the holotype. d. The tail of the holotype. e. The tail of male 2, with fully developed spicules. f. The tail of the allotype.

lacks denticles in its inner surface. Nerve ring at 59–63% (61% in holotype) of esophagus length from anterior end. Excretory system indistinct. Intestine oligocytous, with a ventral and a dorsal rows of large cells. Tail conical, 81–88 μm (86 μm in holotype) long, or 3.0–3.8 (3.6 in holotype) times as long as the cloacal diameter. Bursa present in matured males on each subventral side around cloaca. Each bursa supplemented with two accesory papillae on its lateral margin. A pair of minute subventral papillae present near tail end. Only two caudal glands. Single outstretched testis lies right to intestine and extends anteriorly to 42–218 μm (42 μm in holotype) after base of esophagus. Spicules smooth, slightly cephalate proximally, and 1.7–2.5 (1.8 in holotype) times as long as cloacal diameter. Middle part of fully developed spicule concaved ventrally [Fig. 2.e]. Gubernaculum only weakly developed and lies near distal end of spicule.

Description of females:

♀$_1$ (allotype)

$$\frac{-\quad 131 \quad 632 \quad 889}{14 \quad 26 \quad 32 \quad 21} \quad 989\ \mu\text{m};$$

a=30.9, b=7.5, c=9.9

Vu=63.9%

♀$_2$

$$\frac{-\quad 148 \quad 650 \quad 893}{13 \quad 24 \quad 28 \quad 20} \quad 1002\ \mu\text{m};$$

a=35.8, b=6.8, c=9.2
Vu=64.9%

♀3

—	152	650	902	1008 μm;
—	26	30	24	

a=33.6, b=6.6, c=9.5
Vu=64.5%

♀4

—	134	614	844	943 μm;
—	30	34	24	

a=27.7, b=7.0, c=9.5
Vu=65.1%

♀5

—	154	611	842	951 μm;
—	27	32	23	

a=29.7, b=6.2, c=8.7
Vu=64.2%

General body shape similar to that of males. Tail 99–109 μm (100 μm in allotype) long, or 4.1–5.5 (4.8 in allotype) times as long as anal diameter, smooth without anal alae nor caudal papillae. Gonad unpaired, outstretched, and lies to right of intestine. A large egg present in uterus of the allotype, measuring 42×19 μm and segmented into the 2-cell stage.

Etymoloty: *brevis* from the short body length.

Remarks: The present new species, *Monhystrium brevis,* resembles *M. transitans* Cobb, 1920, but it is quite different from the latter in that it has much shorter cephalic setae. *M. brevis* can be easily distinguished from *M. tenuis* by its shorter and stouter body; De Man ratio **a** of the former is from 27.4 to 35.8 while that of the latter is from 43.6 to 48.2. *M. brevis* had been collected from *Chiromantes haematocheir, C. dehaani,* and *Chasmagnathus convexus* of Koto River. It was also found in *Sesarmops intermedium* from Shirahama, while *S. intermedium* of Koto River and Ariho River seems to be free of them.

DISCUSSION

Two new species of *Monhystrium, M. tenuis* and *M. brevis,* as well as one species of *Gammarinema* were recorded from 8 species of sesarmin crabs (Table 1). Adults of these crabs had the gills dirty with detritus and were also infested by harpacticoids and rotifers, but younger crabs had clean gill surface and were free of such animals. On the other hand, *Perisesarma bidens, Helice tridens, H. japonica,* and 4 species of Ocypodidae, which were not parasitized by *Monhystrium,* had clean gill surface with little detritus. It may safely be said that two new species of *Monhystrium* prefer crabs with dirty gills, probably, feeding on detritus on the gill surface, which accords with the observation by Riemann [11] that *Monhystrium inquilinus* feeds on such detritus.

TABLE 1. Distribution of *Monhystrium tenuis* n. sp., *M. brevis* n. sp. and *Gammarinema* sp. in the gill chambers of sesarmin and ocypodid crabs from Ube, Onoda, and Shirahama

	M. t.	*M. b.*	*G.* sp.
Chiromantes haematocheir		+	
Chiromantes dehaani		+	+
Parasesarma plicatum	+		
Parasesarma pictum	+		
Parasesarma erythrodactylum	+		
Perisesarma bidens			
Sesarmops intermedium		+	+
Helice tridens			
Helice japonica			
Chasmagnathus convexus		+	
Clistocoeloma merguiense	+		
Uca lactea lactea			
Scopimera globosa			
Ilyoplax pusilla			
Macrophthalmus japonicus			

Although both *Monhystrium tenuis* and *M. brevis* were parasitic on crabs with dirty gills, they never occurred in the same species. *Monhystrium tenuis* were found in such crabs as *Parasesarma plicatum, P. pictum, P. erythrodactylum,* and *Clistocoeloma merguiense,* living in the upper littoral zone near the river mouth. *Monhystrium tenuis* especially prefer *Parasesarma erythrodactylum* and *Clistocoeloma merguiense* which are abundant on soft substratum. *Parasesarma pictum* are occasionally found around such habitat, but primarily they are inhabitants on rocky substratum, and the infection rate of *M. tenuis* was very low.

On the contrary, *Monhystrium brevis* were col-

lected from the gill chambers of *Chiromantes haematocheir, C. dehaani, Sesarmops intermedium* and *Chasmagnathus convexus,* living higher in upper littoral zone or in supralittoral zone. The infection rate of *M. brevis* was highest in *Chiromantes haematocheir,* which is highly adapted to terrestrial environment and scarcely goes down into sea water. *Chasmagnathus convexus,* a supralittoral inhabitant, was infested by a moderate number of *M. brevis. Chiromantes dehaani* is distributed mainly in the upper littoral zone, and the density of *M. brevis* on their gill surface was very low. In Koto River and Ariho River, *Sesarmops intermedium* are distributed in the upper littoral zone, and they were not parasitized by *M. brevis.* At Shirahama, *S. intermedium* were collected higher in the supralittoral zone together with *Chiromantes haematocheir,* and they were intensively infested by *M. brevis.*

In conclusion, *Monhystrium tenuis* appears to prefer sesarmin crabs living on soft substratum in the upper littoral zone near the river mouth, while *M. brevis* to such crabs inhabiting the supralittoral zone without close contact with sea water. The gills of these crabs are dirty with detritus and both species of *Monhystrium* seem to feed on such detritus.

ACKNOWLEDGMENTS

The author gratefully acknowledge Dr. Eiji Harada, Seto Marine Biological Laboratory, Kyoto University, for his valuable suggestion during the completion of the manuscript. Thanks are also due to Dr. Sievert Lorenzen, Zoologisches Institut, Universität Kiel, for his critical reading of the manuscript.

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